IMPACT

BIG DATA OPTIMISES FORESTRY

EFFORTE

Luke
NATURAL RESOURCES INSTITUTE FINLAND

BIO-BASED INDUSTRIES

Bio based Industries Consortium

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Increasing efficiencies in the forestry industry

*In order to meet increasing efforts to switch to a sustainable bio-economy, the **EFFORTE** project is aiming to use Big Data to improve the sustainability, efficiency and productivity of Europe's forestry sector*

Forests are one of society's oldest resources; providing fuel, food and building materials for centuries. Overuse and concerns about deforestation, rightly, forced nations to reconsider how they exploit this renewable resource. Now, more than ever, the forestry industry requires innovative solutions to increase yield and efficiency, while simultaneously reducing the environmental impact. The emergence of the bio-economy in Europe and the focus the European Union has placed on fostering sustainable industries means there is growing demand for forestry products as raw materials and, therefore, a need to re-invent the way forestry projects and environments are managed.

Forestry management and silviculture (the practice of growing and cultivating trees) is an industry based on a sequence of events that unfold over a long period of time; each event influencing the timing and productivity of the next. This, chainlike structure to the industry lends itself to optimisation using modern data, systems and analysis methods. Moving along the chain, gathering data, gives managers an opportunity to increase efficiency and add value, not only to each event, but as a consequence to the whole process. According to Jori Uusitalo, Project Coordinator of the EFFORTE (Efficient forestry for sustainable and cost-competitive bio-based industry) project says: 'Using modern GIS-based technologies together with information about stand and soil properties provides a way forward towards the long-term goals of increasing revenues and forest production while reducing unwanted negative environmental impacts on soils and waters.'

ACHIEVING PRECISION FORESTRY

EFFORTE, a 3 year project which started in late 2016, is a 'research and innovation project providing the European forestry sector with new knowledge and know-how' says Uusitalo. This is a collaboration of 23 partners across Europe funded by the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme. The knowledge they are seeking comes in the form of Big Data and the know-how is new methodologies and practices based on that data. The project has identified several areas where innovation can increase efficiency and reduce environmental impacts. Namely, mechanisation of formerly manual process, improved understanding of soil stability and trafficability by machines and Big Data solutions to increase efficiency and move from classic large stand management methods towards precision forestry.

In order to achieve the goals set forth in these areas EFFORTE has devised three themes to update the forestry industry: digitalisation, precision-forestry and terrain trafficability. Essentially, by having better data, better management decisions can be made. In order to accomplish this the focus is set on what types of data are needed and how this is collected.

Firstly, terrain trafficability, or soil bearing capacity, is an area that can have a huge initial impact. Forestry relies on machines, and this is only set to increase as mechanisation efforts ramp up. However, machines are heavy and cause rutting in the soil, which damages the environment, and the machines can get stuck or simply cannot operate in certain conditions. Having machines sit idle is also one of the biggest money sinks for forestry operations. A better understanding of onsite soil conditions and changing weather patterns will allow the scheduling of work to be more efficient and consequently less damaging for the environment. Apart from scheduling, operating in optimal conditions reduces energy consumption and results in wear on the equipment.

Secondly, precise data on topography and soil allows for precision forest management. Knowing which types of trees to plant and when greatly increases output and efficiency; reducing the amount of loss and streamlining the work flow from planting to harvesting. 'Different tree species thrive under different conditions, so the forest's soil, dryness, humidity and elevation differences have to be taken into account,' explains Uusitalo. This is precision forestry and overall it will allow for better use of the environment, equipment and increase the number of processes that can be mechanised.

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The final theme deals with how to collect and interpret the necessary data. Big Data analysis is a field of its own and the techniques already used for geospatial and weather analysis can be incorporated with new forms of data collected by forestry machines themselves. Knowledge about the engine power required to move machines combined with current weather conditions will aid predictive models, giving estimates of on actual soil types and terrain trafficability, to be used in the following forest operations in this specific forest stand.

INDUSTRY PARTNERS IMPLEMENTING RESULTS

EFFORTE has already begun to pilot some of their new techniques, alongside partners from industry around Europe. One project is already producing results in the forms of improved trafficability maps. The team have taken advantage of existing data sources, such as the detailed digital elevation model, that is freely available in most European countries. Bringing together multiple data sources as well as piloting some collection methods of their own, EFFORTE has developed and tested Depth-to-Water (DTW) maps and Static and Dynamic trafficability maps in aiding forest operations in practise. The DTW map, based on detailed digital elevation model (DEM), provides estimate on where soil water is most probably flowing and accumulating. The static trafficability maps are also based on DEM and calculation of water flows but in addition to that they also take into account soil type and information on tree volumes. The dynamic trafficability maps can even combine weather data to previous data sets and give prognosis on daily topsoil water content. It is important to note the role of industry partnerships in a project such as this. Industry and academia often have different information and ideas about the same topics. By sharing information and working together, successful innovations can be piloted and put into practice more rapidly. EFFORTE, therefore, benefits from its industry partners, representing the largest forestry companies in Sweden, Finland, Scotland and France.

GENERATIONS OF VALUE

Concerns over deforestation and management are legitimate, but when managed properly forests and forest products can provide an abundant and continued source of materials and energy. This makes initiatives like EFFORTE key to the future of the bio-economy. As the methods and technologies that allow better processing of lumber improve, the number of projects that can be accomplished with wood will increase. Already, engineers are putting forth designs for large scale wood buildings and infrastructure projects. How we protect and use our forest resources will help determine if we can change the world from oil based industries to bio-based ones; an effort that could go a long way to securing a more sustainable economy and liveable planet for generations to come.

Project Insights

FUNDING

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PARTNERS

Agroscope (Switzerland) • Comptoir des Bois de Brive (CBB) (France) • Creative Optimization Sweden AB (Sweden) • Forets et Bois de L'est Société Cooperative Agricole (FBE) (France) • Holmen Aktiebolag (Sweden) • Institut Technologique Foret Cellulose Bois-Construction • Ameublement (FCBA) (France) • James Jones and Sons LTD (UK) • Metsä Group (Finland) • Metsäteho Oy (Finland) • Natural Resources Institute Finland (Luke) (Finland) • Office National des Forets (ONF) (France) • Oy Arbonaut Ltd (Finland) • SCA Skog AB (Sweden) • Société d'Exploitation Forestiere de l'Est (SEFE) (France) • Södra Skogsagarna Ekonomisk Förening (Södra) (Sweden) • Stiftelsen Skogsbrukets Forskningsinstitut – Skogforsk (Sweden) • Stora Enso OYJ (Finland) • Stora Enso Skog AB (Sweden) • Sveaskog Förvaltnings AB (Sweden) • Sveriges Lantbruksuniversitet (SLU) (Sweden) • Union Francaise Industries Cartons, Papiers et Celluloses (COPACEL) (France) • UPM-Kymmene OYJ (Finland) • Woodilee Consultancy LTD (UK)

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BIO

Dr Jori Uusitalo is a leading scientist in the field of forest technology and wood supply chain management. Since submitting his dissertation at the University of Helsinki in 1995, he has worked as a post-doctoral researcher at the University of Illinois, as a professor in forest engineering at the University of Joensuu and as a Unit Director and Regional director in Metla. He currently works as Group Manager of the Forest Technology and Logistics Group in Luke. Uusitalo has coordinated numerous national and international research projects in the field of forest operations and wood working industry. He has previously coordinated the international research project Woodvalue.

Impact Objective

- Provide the European forestry sector with new knowledge and know-how to significantly improve the possibilities of forest enterprises in order to assemble and adopt novel technologies and procedures

Big Data optimises forestry

The forestry industry faces new challenges, from climate change to increasing demand for material by the bio-economy, and it needs new approaches to meet these demands. ***Jori Uusitalo****, coordinator of the pan-European* ***EFFORTE*** *collaboration, discusses applying data driven solutions to achieve this*

What are the aims of the EFFORTE initiative and what will the ultimate impact be on the forestry industry?

We aim to develop methodology to predict trafficability of forest stands prior to operations, increase forest growth and achieve higher productivity of tree planting and young stand management, as well as, develop, customise and pilot modern 'Big Data' solutions that increase productivity and decrease negative environmental impact of forest operations.

We want to provide the European forestry sector with new knowledge and information that will significantly improve the possibilities of forest enterprises to assemble and adopt novel technologies and procedures. This will in turn, enhance efficiency, promote sustainable forestry, foster an increase in forest growth, support a cost-competitive bio-based industry and accelerate regional economic development.

What are some of the major challenges facing Europe's forestry sector and how do you envisage EFFORTE will address any of these?

The major challenges are climate change and growing interests in utilising forests as a raw material. EFFORTE will develop tools that help forest managers to master these challenges. For example, climate change increases the number of days when forests are not covered by frost and snow. These wet conditions increase the risk of rutting and compaction; a major environmental impact of forestry. Therefore, methods to predict the strength of soil in different conditions are essential to knowing when operations can proceed.

EFFORTE aims to not only reduce the impact of forestry industries but simultaneously increase efficiency as well. Can you explain some areas where these goals can be achieved?

Yes, EFFORTE aims to increase forest operations' output while minimising environmental impacts. More accurate prior knowledge, based on pre-harvest cruising or big data-applications, enables optimal scheduling of forest operations based on their sensitivity to changing conditions; a big source of inefficiency is machines standing idle during poor weather conditions. Better monitoring and scheduling offers the significant possibility to increase annual machine utilisation, while avoiding destruction to the environment. Besides the work efficiency itself, profitability of forestry can be improved by more clever work methods that reduce the number of treatments within the forest rotation. In this work, utilisation of the most modern stand simulators is of the greatest importance. All forest operations are associated with a rather big share of auxiliary field work related to planning, leadership and control. Adoption of Big data-applications not only improves the quality of the work but also minimises pre-harvest and post-harvest field work. Decreasing the proportion of forest stands with a high rate of disturbances will also lead to a greater acceptance of the forest operations among forest owners and the general public.

How has forestry knowledge changed in the last 10 years with the vast improvement in the availability of data and how can EFFORTE leverage this?

In many European countries, new legislation for supporting Big Data which has been collected by public funding has opened the wide possibilities for novel big data applications. In most countries, topographical data with high spatial accuracy is available for all users. In addition to this, more accurate tree inventory data, based on airborne laser scanning campaigns, has made novel Big Data solutions possible. Solutions like the precision forestry philosophy whereby dividing tree stands into smaller units allows for management at the stand, micro stand, grid cell or tree-by-tree level.